

HepMC Analysis Tool

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Idea

Provide a framework for physics analysis of generated events for:

- **generator validation** (e.g. new generators, version upgrade)
- **generator tuning** (comparisons to data)
- **generator comparisons** (comparisons of different generators)

Physics analysis goals

Cover all physics aspects of event generation,
i.e. implement distributions sensitive to

- hard process
- parton shower
- underlying event
- decay properties
- fragmentation
- pdfs

Technical design goals

The framework software has to be

- **Robust:** checkout and run
- **Simple:** easy to understand code (also for C++ newbies)
- **Scalable:** easy to extend for user analysis or for other applications

Applications

- Use by GENSER for histogram based validation of generators
- Use in Atlas analysis framework for generator validation
- Use for generator comparisons

Technical implementation

- Generate events and output in HepMC format (as provided by the generators)
- Provide a HepMCAnalysis class library to analyse the HepMC format and produce root histogram output
- Limit dependency on other codes: HepMCAnalysis depends on HepMC, FastJet and Root
- Provide additional tools for automated histogram comparison and web based displays

Class implementation

- One class for each physics analysis topic
- Classes for reconstruction algorithms, e.g. jets, Etmis
- Base class for common interface:
 - Init() : histogram initialisation
 - ProcessEvent(HepMC::GenEvent *event): analysis of HepMC event
 - Finalise(): writing histograms to file
- Classes can be included into each other

Physics implementations - Top

- Process: $pp \rightarrow t\bar{t}$
- Histogramms:
 - top pt
 - pt of $t\bar{t}$ system
 - ncharged particles
 - angle between W and top
 - Angle between W from top and W from \bar{t}

Physics implementations underlying events

- Process: $pp \rightarrow Z$
- Histogramms:
 - Ncharged particles vs highest pt jet in transverse, towards and away region
 - Ncharged (track $pt > 500 \text{ MeV}$) vs eta

Tau

- Process: $pp \rightarrow Z \rightarrow \tau \tau$
- Histogramms:
 - Tau pt, eta phi
 - Ntrack of tau decay
 - Energy in charged+neutral detectable particles
 - Highest pt track

Jets

- Process: $pp \rightarrow Z + \text{jets}$, $pp \rightarrow W + \text{jets}$
- Histogramms:
 - Nr of jets
 - # events with >1 jet, >2 jets, ..
 - (sub)leading jet distributions: E_t , η
 - Boson p_t , W transverse mass
 - Lepton E_t from W decay

Dijets

- Process: $pp \rightarrow 2 \text{ jets}$
- Histogramms
 - As for jets
 - D_{ϕ} between jets
 - DR between jets

PDFs

- Process: $pp \rightarrow W$
- Histogramm:
 - W vs η

Status

- Framework development with first implementations
 - CVS repository set-up
 - Makefile
 - First class (TopAnalysis)
 - First generator (pythia8)
- Contributors welcome!